# APPLICATION UNDER UNITED STATES PATENT LAWS

Invention: **SIMPLIFYING DSL DEPLOYMENT VIA ANALOG/DSL COMBINATION SOLUTION**

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This is a:

[ ] Provisional Application

[X] Regular Utility Application

[ ] Continuing Application

[ ] PCT National Phase Application

[ ] Design Application

[ ] Reissue Application

[ ] Plant Application

# SPECIFICATION

# SIMPLIFYING DSL DEPLOYMENT VIA ANALOG/DSL COMBINATION SOLUTION

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

This invention relates generally to deployment and use of digital data services via a telephone line. More particularly, it relates to the use an analog/DSL modem to automatically and/or remotely determine a capability of potential subscribers' telephone line to support DSL services in addition to analog voice services.

### 2. Background of Related Art

The growing demand for access to networked resources (such as via the Internet) has led to increasing interest in higher speed broadband connections. A typical way to access network resources is via dial-up connections using analog dial modems.

The advent of digital subscriber line ("DSL") services has enabled a promising way to access network resources. DSL is a copper loop transmission technology which utilizes the existing voice telephony copper (i.e., telephone line), but delivers a higher information rate than analog dial-up technology.

Fig. 8 shows the frequency spectrums of traditional analog voice and asymmetric DSL.

Voice telephony and current analog dial-up modems limit their transmission spectrums to a 0 to 3.4 kHz range for a voice channel **801** as shown in Fig. 8. The highest information rate currently achievable within a 3.4 kHz spectrum is 56 kbps.

DSL achieves a higher information rate by using a broader range of frequencies than an analog voice channel **801**. For example, asymmetric DSL ("ADSL) utilizes frequencies up to 1.2 MHz for faster

data services versus using an analog voice channel. As shown in Fig. 8, ADSL technologies utilize a separate upstream channel **802** and downstream channel **803**. Today, ADSL transmits an asymmetric data stream at up to 1 Mbps upstream (to the network) and up to 7 Mbps downstream (to the subscriber).

Transmission of data over a broader range of frequencies using DSL technologies such as ADSL requires complementary DSL devices at each end of a copper loop.

Fig. 6 shows a general topology for conventional DSL services.

In particular, Fig. 6 shows a typical subscriber location **601** with DSL service and plain old telephone ("POT") service. A subscriber's personal computer **602** is connected to a DSL modem **603**. The DSL modem **603** is connected via inside wiring **604** to a network interface device ("NID") **607**. At the NID, the inside wiring **604** is connected to a DSL service line **608a.** The DSL service line **608a** is routed to a serving central office **609**. The DSL service line is connected via a main distribution frame ("MDF") **613** to a complementary DSL device **612** (such as a DSL access multiplexer or "DSLAM") within the central office **609**. A high speed connection **614** (such as a T1, DS3, etc.) connects the complementary DSL device **612** to a data network (such as the Internet).

~~As shown in Fig. 8, DSL service is typically provided using a separate service line from a subscriber's traditional POT service. A subscriber's telephone **605** is connected via inside wiring **606** to the NID **607**. Of note, a subscriber's POT service line **608b** is separate from the dedicated DSL service line **608a**. At the NID, a subscriber's POT service is routed via the POT service line **608b** to the service central office **609** into the MDF **613**. The subscriber's POT service is then routed to the public switched telephone network ("PSTN") **611**.~~

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One problem with DSL services is that they are difficult to deploy because a separate service line may be required. Moreover, there are many inefficiencies in the current process which has slowed the deployment of DSL.

It is desirable for DSL network service providers to deploy service quickly when requested by their subscribers. Furthermore, quick deployment of DSL service can reduce operations costs, increase revenue, improve customer satisfaction and speed up deployment.

Today, DSL deployment requires four steps: (1) prequalification; (2) copper provisioning; (3) turning on the service; and (4) post installation issues.

Fig. 7 shows a conventional process of deploying DSL.

In particular, in step **701** a subscriber submits an initial request to a network service provider for DSL service.

In step **702**, a network service provider will conduct a prequalification of a subscriber.

Prequalification attempts to determine whether a subscriber location can support DSL service. However, DSL has several limitations which prevent deployment under certain circumstances. For instance, several factors which might prohibit a subscriber's location from supporting DSL services include:

- Distance from the central office is too far (e.g. greater than 12,500 feet for ADSL).
- Subscriber location is served by a remote terminal.
- Bridge taps are present in the copper pair.
- Load coils are present in the copper pair.

Typically, a network service provider will estimate a subscriber's distance from their serving central office based on an address and phone number. Also, a network service provider will check written records to determine if any limiting factors are present (e.g. remote

terminal, bridge taps, load coils, etc.). If the distance is estimated to be too far, or if written records indicate the presence of any limiting factors, then a network service provider will often not even attempt to deploy DSL service to that subscriber because of cost concerns.

In step **703**, if a subscriber location passes prequalification, a network service provider then provisions a connection from the subscriber's location **601** to the central office **609** and finally to the service provider's complementary DSL device **612** via the MDF **613**. This process is known as copper provisioning and requires coordination between the network service provider and the local exchange carrier ("LEC").

In steps **704** and **705**, if copper provisioning is successful, the next step is to turn on DSL service over the delivered connection **608a** (i.e., telephone line). Turning on DSL service involves terminating the connection at the appropriate point on a service provider's complementary DSL device **612** and installing a DSL modem **603** and any necessary inside wiring **604** at the subscriber's location **601**. This is done by the network service provider from whom the subscriber ordered DSL service.

Ideally, when turning on service a technician arrives at the subscriber's location **601**, installs the inside wiring **604**, installs the DSL modem **603**, tests the DSL service and leaves the premises within ninety minutes.

Unfortunately, there are many inefficiencies with the current process during each of the steps **701-706**.

During prequalification, the written records available to a network service provider are often inaccurate. In addition, the written records often cover only the copper pair used for a DSL service line **608a** from the central office **609** to the NID **609**. Written records often do not provide complete information as to the state of inside wiring **604** within the subscriber location **601**. Inside wiring **604** may be a myriad of wire types, gauges, and of any configuration which can impact the performance of

DSL. As a result, network service providers are often forced to dispatch technicians to a subscriber's location and install new inside wiring.

During copper provisioning, coordination with the LEC often takes a substantial amount of time (e.g. several weeks) to provision a connection from the subscriber's location **601** to the central office **609**. Provisioning a connection from the MDF **613** to the service provider's complementary DSL device **612** may also take a substantial amount of time.

In addition, there are often errors which may not be discovered until later. For example, a misconnection to a wrong location other than the subscriber location **601**, or a misconnection at the MDF **613** or a misconnection at the service provider's complementary DSL device **612** may be discovered late in the process.

Moreover, when turning on the service, the technician may discover misconnections at the service provider's complementary DSL device **612** or at the subscriber's location **601**. For instance, the technician may discover load coils and/or bridge taps during testing which were not identified in the written records. Also, the distance from the central office **609** to the subscriber's location **601** may have been inaccurately estimated causing a need to down-grade DSL service from that which was ordered initially. Any of these problems can lead to lost revenue to the network service provider as well as subscriber dissatisfaction.

Post installation issues **706** can also be difficult. For example, troubleshooting DSL service can be a lengthy and difficult process. When a problem with DSL service occurs, a network service provider may need to dispatch a technician. During troubleshooting, a technician must usually travel to the subscriber location **601** to check for a failure in the DSL modem **603**, in the subscriber's PC **602**, or in the inside wiring **604**. The technician may also need to travel to the central office

**609** to check the service provider's complementary DSL device **612** or verify the connection from the MDF **613**. If the equipment is in order, the technician may then have to use DSL test equipment which places tones on the DSL service line **608a** to detect any problems. This process is labor intensive and can take a substantial amount of time.

Accordingly, as described above, DSL deployment is a labor intensive process with many inefficiencies.

Thus, there is need for an improved process and apparatus for deploying DSL in a way and at a cost that meets the expectations of both the consumer as well as the DSL network service provider.

## SUMMARY OF THE INVENTION

In accordance with the principles of the present invention, a method for deploying digital subscriber line (DSL) service via a combination analog/DSL modem comprises logging a subscriber into a network site via an analog modem portion of a combination analog/DSL modem; determining a suitability of a service line used by the subscriber for supporting DSL service via the combination analog/DSL modem; and approving installation of DSL service on the service line when the suitability is determined to support DSL service.

In accordance with another aspect of the present invention, a computer program product for deploying DSL services via a combination analog/DSL modem comprises a computer usable medium having computer readable program code, the computer readable program code including: program code for logging into a network site via an analog modem portion of a combination analog/DSL modem; program code for determining a suitability of a service line for DSL services via the combination analog/DSL modem; and program code for installing DSL services when said service line is determined to be suitable to support DSL services.

In accordance with another aspect of the present invention, a combination analog/DSL modem comprises an analog modem module; a DSL modem module; a parameter test module adapted to measure at least one parameter of a service line via the analog modem module; and a parameter reference module adapted to correlate the measurement by the parameter test module to a suitability for supporting services via the DSL modem module.

## BRIEF DESCRIPTION OF THE DRAWINGS

Features and advantages of the present invention will become apparent to those skilled in the art from the following description with reference to the drawings, in which:

Fig. 1 shows an exemplary topology for DSL services in accordance with the principles of the present invention.

Fig. 2 shows a more detailed depiction of a combination analog/DSL modem.

Fig. 3 shows a more detailed view of a serving central office.

Fig. 4 shows an exemplary process for deploying DSL, in accordance with the principles of the present invention.

Fig. 5 shows how post installation issues such as troubleshooting may be handled as part of deploying DSL service, in accordance with the principles of the present invention.

Fig. 6 shows the bandwidth of a traditional analog voice channel and the bandwidth of the upstream and downstream channels of conventional asymmetric DSL technology.

Fig. 7 shows a general topology for conventional DSL services.

Fig. 8 shows a conventional process for deploying DSL services.

## DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

The present invention provides an automated process for deploying DSL services using a combination analog/DSL modem.

Fig. 1 shows an exemplary topology for DSL services in accordance with the principles of the present invention.

In particular, as shown in Fig. 1, a subscriber location **101** includes subscriber equipment **103** (e.g. a personal computer), a combination analog/DSL modem **107**, a traditional telephone **105**, and a splitter **106** is shown within a subscriber location **101**.

The subscriber's equipment **103** is connected to a combination analog/DSL modem **104**. The combination analog/DSL modem **104** is connected to a splitter **106** via inside wiring **107a**. The splitter **106** allows the copper service line **109** to be used for simultaneous DSL transmission and transmission using the analog voice channel. The splitter **106** is connected to a NID **108** via inside wiring **107b**. Analog voice traffic from a telephone **105** is also routed through the splitter **106** to the NID **108**.

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From the NID **108**, a copper service line **109** carries the DSL and analog voice traffic to a serving central office **110**. DSL traffic is routed to a data network **112** (e.g. the Internet). A network site **113** is accessible via the data network **112**. Analog voice traffic is routed to the PSTN **114**.

Fig. 2 is a more detailed depiction of the combination analog/DSL modem shown in Fig. 1.

In particular, a controller **201**, a parameter test module **203**, parameter reference module **202**, DSL modem module **205**, and analog modem module **204** is shown within a combination analog/DSL modem **109**.

The controller **201** controls the operations of the combination analog/DSL modem. The controller controls the passing of

information between the parameter test module **203** and DSL modem module **205**, and analog modem module **204**. The controller **201** also allows the subscriber to select data transmission using the DSL modem module **205** or analog modem module **204**.

The parameter test module **203** in conjunction with the parameter reference module **202** allows for testing of the wiring between the combination analog/DSL modem **104** and the serving central office **110**. The parameter test module **203** uses algorithms and DSP code known by those of ordinary skill in the art to measure several parameters. Suitable parameters measured may include signal amplitude, return echo, tip voltage, ring voltage, capacitance and /or impedance to determine, e.g., line length, noise, presence of load coils, and presence of bridge taps.

Although several parameters are disclosed, other parameters which may affect suitability of supporting DSL service may be implemented within the principles of the present invention.

The parameter reference module **202** correlates the parameters measured by the parameter test module **203** to a suitability of the copper service line **109** for supporting DSL service. For example, line length may be correlated to the measured capacitance, e.g., by using 0.078-0.086 µF/mile, in determining whether the service line **109** is too long (e.g. greater than 12,500 ft).

Although a correlation of capacitance to line length is disclosed, other correlations to determine a suitability for a copper service line **109** may be implemented within the principles of the present invention.

The analog modem **204** allows for data transmission using an analog dial-up session known by those of ordinary skill in the art. The analog modem **204** preferably allows for data transmission up to 56 kbps using an analog voice channel.

Although a 56 kbps analog modem is shown, other analog modems which use an analog voice channel may be implemented within the principles of the present invention.

The DSL modem **205** allows for data transmission using DSL technology. The DSL modem **205** preferably uses ADSL technology known by those of ordinary skill in the art.

Although ADSL technology is disclosed, other DSL technologies which allow for simultaneous DSL transmission and analog voice channel transmission over the same service line may be implemented within the principles of the present invention.

Fig. 3 shows a more detailed view of a serving central office.

In particular, an MDF **301**, POTS splitter **302**, complementary DSL device **303**, and analog dial point of presence ("POP") **304** is shown.

The MDF **301** aggregates incoming service lines and routes traffic to appropriate locations. Analog dial-up session traffic from the analog modem module **204** is routed to the analog dial POP **304**. Analog voice traffic from the telephone **105** is routed to the POTS splitter **302** and to the PSTN **114**. DSL data traffic from the DSL modem module **205** is also routed to the POTS splitter **302** but directed to the data network **112**.

The POTS splitter **302** acts as a corresponding device for the splitter **106** located at the subscriber's location **101**. The POTS splitter **302** and splitter **106** are devices known by those of ordinary skill in the art which operate in conjunction to allow for simultaneous DSL and analog voice channel transmission over the service line **109**.

Although a splitters, other DSL technologies which allow for simultaneous DSL and analog voice channel transmission over the same service line may be implemented within the principles of the present invention.

The complementary DSL device **303** serves as a corresponding modem device to the DSL modem module **205** which connects to the data network **112** via a high speed connection **111**. The complementary DSL device **303** is preferably a DSL access multiplexer ("DSLAM") as known by those of ordinary skill in the art.

The analog dial POP **304** serves as a corresponding modem device to the analog modem module **204** which also connects to the data network **112** via a high speed connection **113**. The analog dial POP **304** preferably supports up to 56 kbps as known by those of ordinary skill in the art.

High speed connections **111** and **113** preferably support at least T1 speeds (i.e. 1.5 Mbps) or higher as known by those of ordinary skill in the art.

Although a 56 kbps analog dial POP is shown, other analog dial POPs which use an analog voice channel may be implemented within the principles of the present invention.

Fig. 4 shows an exemplary process of deploying DSL in accordance with the principles of the present invention.

In particular, in step **401** a subscriber via the analog portion of a combination analog/DSL modem logs into a network site to request DSL service.

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Preferably, the subscriber may log into a network site **113** by inserting a computer program product **102** (e.g. a diskette or CD) to initiate an analog dial-up session via the analog modem module **204** of the combination analog/DSL modem **104**. The subscriber may receive the computer program product **102** via a directed mailing or by any wide variety of means.

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Preferably, upon logging into the network site **113**, the user is prompted to provide certain information such as address, and phone

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number. However, other information may be requested from the user in accordance with the principles of the present invention.

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In step **202**, a series of parameter tests is performed by the combination analog/DSL modem **104**. As noted above, these parameter tests are handled automatically without the need for manual intervention by the combination analog/DSL modem **104** using algorithms and DSP code known by those of ordinary skill in the art to measure several parameters.

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These measured parameters are then passed automatically to the network service provider operating the network site **113**.

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In step **203**, a suitability for supporting DSL services is automatically determined by the network service provider based on an analysis of the parameters measured by the combination DSL/analog modem **104**.

The parameters measured by the combination DSL/analog modem **104** may be automatically compared without manual intervention to the technical requirements of DSL, although manual assistance may be provided within the scope of the present invention. The resulting suitability determined is then passed automatically to the network service provider.

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In step **203b**, if the measured parameters are not within technical limits, then the subscriber is notified that DSL service is not available. The notification may also include the reason why DSL service is not available (e.g. distance too far, bridge tap detected, etc.).

Notification may be delivered to the subscriber by a wide variety of ways such as email, or written notification. Preferably, the subscriber is notified via email within 24 hours.

Although, email or written notification is disclosed, other types of notification which allow for quick delivery, e.g., within 24 hours may be used in accordance with the principles of the present invention.

In step **203a**, if the measured parameters are within technical limits, the subscriber is informed that DSL service is available. The network service provider may then substantially immediately offer DSL service to that subscriber, without requiring the dispatch of any personnel (and potentially without the expenditure of any man-hours). A subscriber may be informed by a wide variety of means such as email, or written notification. Preferably, the subscriber is immediately informed via email.

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In step **204**, a subscriber responds positively to the offer of DSL service and submits an order. A subscriber may submit an order by replying to a notification email, filling out a written notification sent to the subscriber, or calling the network service provider. Preferably, the subscriber submits an order via email.

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In step **205**, the network service provider responds to the subscriber's order by provisioning a connection between the subscriber's location **101** and the network service provider's complimentary DSL device **108**, and updates service turn-on and billing information. Preferably, this would occur, e.g., within 24 hours.

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In step **206**, the network service provider informs the subscriber that DSL service has been turned on. Notification may be by a wide variety of means such as email or written notification. Preferably, the subscriber is notified via a suitably fast and automatic mechanism, e.g., email perhaps in conjunction with a written notification by regular mail.

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In step **207**, the subscriber turns on DSL service by selecting the DSL portion of the combination analog/DSL modem **104**, and substantially immediately gains access to network resources.

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Fig. 5 shows how post installation issues such as troubleshooting may be handled as part of automatic deployment of DSL service, in accordance with the principles of the present invention.

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In particular, in step **208**, the subscriber discovers a problem with his/her DSL service, and accordingly notifies the network service provider. A problem may be noted at any time, and by any of a wide variety of symptoms, such as slow performance, error messages, etc.

Notification to the network service provider may be by any of a wide variety of means such as email, or phone call. Preferably, the network service provider is notified via a suitably fast mechanism, e.g., via email.

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In step **209**, the network service provider may respond to the problem report by the subscriber. In order to troubleshoot the DSL service, the subscriber or network service provider may remotely and automatically direct the combination analog/DSL modem **104** into a test mode.

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In step **210**, the network site **113** is logged into for troubleshooting, and the combination analog/DSL modem **104** initiates any one of a series of tests via the analog modem module **204** or DSL modem module **205** to determine the current suitability of the service line. These troubleshooting tests are preferably handled automatically without manual effort. The results of these troubleshooting tests may then be passed automatically to the network service provider for analysis.

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In step **211**, the network service provider may analyze the remotely received information and appropriately isolate and potentially resolve the problem without ever having dispatched a repair crew to the subscriber's premises. Diagnosis may be performed by a wide variety of ways without manual effort.

Ideally, within 24 hours the service turn-on and billing information are updated and the subscriber is notified by the network service provider. In response, the DSL modem module **205** of the combination analog/DSL modem **104** would be selected and a subscriber

would immediately have broadband access to the desired network resources.

Also, since the combination DSL/analog modem **104** is located at the actual location, i.e., **101**, where DSL service is delivered, troubleshooting and testing can be initiated at any time by the subscriber or network service provider.

Thus, the present invention provides a method for automating and improving the process of deploying DSL.

Accordingly the deployment of DSL service is improved and made more efficient by reducing the manual effort and other inefficiencies required for the implementation of DSL services over a telephone line.

While the invention has been described with reference to exemplary embodiments thereof, those skilled in the art will be able to make various modifications to the described embodiments of the invention without departing from the true spirit and scope of the invention.